

otherwise. So long as  $|x| < 1$ , Lambert's series defines a function of  $x$ ; calling this  $f(x)$ , a prime number  $\theta$  is distinguished by the fact that it makes

$$D_x^p(x) = 2\theta(p!)$$

when  $x=0$ . There are many remarkable instances of arithmetical truths derived by constructing an enumerative series (purely symbolical, in the first instance) and then investigating its properties as a function of  $x$ . Ultimately, of course, the results obtained must depend upon purely arithmetical considerations; but transcendental analysis supplies, in such cases, a kind of machine, by which, with slight effort, theorems are verified, or even suggested, although the proof of them by strictly arithmetical methods may be very difficult. Whether Lambert's series can be used in this way to simplify the problem of the frequency of primes still remains an open question.

G. B. M.

#### A PLEA FOR INTERACTION.

*Geist und Körper, Seele und Leib.* Von Ludwig Busse. Pp. x+488. (Leipzig : Verlag der Dürr'schen Buchhandlung, 1903.) Price 8.50 marks.

In this book the author aims at finally establishing a doctrine of "interaction." Previous expositions in less comprehensive form have already been criticised by eminent writers; to these objections the author now replies. The result is a veritable encyclopædia of views on this question; authors of all nationalities are here cited to defend themselves against criticisms which are throughout shrewd and relevant. In the mass of material the author's particular theory is apt to be obscured; a strictly methodical procedure has to some extent obviated this defect. After a refutation of materialism, adequate for its purpose as *entrée*, we come to the *pièce de résistance*, entitled "Parallelism or Interaction?" Here parallelism is discussed under the heads modality (is parallelism a metaphysical doctrine or merely a hypothesis?), quantity (must it be partial or complete?), and quality (materialistic, realistic-monistic, idealistic-monistic, and dualistic forms). From this catalogue there finally emerge as "valid forms" only the complete, the realistic-monistic, the idealistic-monistic, and the dualistic forms. The method of criticism employed is called by the author "immanent." Internal dissensions reduce the various doctrines to the vanishing point; those alone survive which do not contain in themselves any elements contradictory to parallelism. The crucial point comes when the idealistic-monistic form is discussed. The author holds an idealistic-spiritualistic doctrine, and is therefore concerned to show that this does not necessitate parallelism, that interaction is not only possible, but preferable. He relies mainly on the unity of consciousness, and the necessity of including activity as subjectively known in our view of the Whole. The arguments against "conservation of energy," "continuity," and naturalistic positions in general are then brought forward. The author is emphatically opposed to any compromises. Between mind and matter the break is abso-

lute; activity without expenditure of energy, the extension downwards to the unconscious or to *quelque chose d'analogique*—in short, compromise of all kind is rejected. Philosophy must here take its stand upon experience, and claim that interaction alone does justice to the facts. The rejection of a preestablished harmony makes it necessary to assert that ultimately we must formulate any given series of events, not as one or as two homogeneous series, either physical (as  $a b c \dots$ ) or psychical ( $\alpha \beta \gamma \dots$ ), but as a compound series of the form  $a \beta c \delta$ , &c. Similarly the rejection of any development of mind from lower elements is followed by the conclusion (after Lotze) that it supervenes on a certain development of "Zellengruppe." It follows that so far as interaction is concerned we must assert a dualism; the two systems which interact must be kept distinct; the ultimate unity is not to be found in their nature, but in the fact of their interaction; we have not to piece together the world, but to accept its living unity.

Clearly such a theory claims attention more for the consequences to which it looks than for the advantages it attains. So far we must regard the Weltanschauung of the closing section as much more than a "dessert." Here there appears an "All-Geist," and with it new possibilities; unfortunately the binder omitted some pages here, and criticism must therefore turn upon him rather than upon the author. As an exposition of how experience may be treated in the interests of a Weltanschauung, we have here an admirable discussion. Much of it is common property among writers on the philosophy of psychology. But refutation has before now proved a two-edged sword, and on the crucial points, the subjects of activity and of development, the author seems to glide from proof to assertion. The idealistic treatment of the two factors said to interact presumably forms the ground of a final unity; the question "how" is more easily solved *ambulando* than *cogitando*. It seems to require more than the author's theory of Thing-monads and Soul-monads—more even than the binder can have omitted.

G. S. B.

#### THE NEW ENCYCLOPÆDIA.

*Encyclopaedia Britannica.* Vol. xxxi. New volumes. Vol. vii. Mos—Pre. (London : A. and C. Black; and the Times Office, 1902.)

THE prominence given to scientific subjects in the seventh of the new volumes of what has long been regarded as our national encyclopædia serves in a measure to indicate how large a part the work of men of science has taken in the increase of knowledge during the last quarter of a century. Among articles of prominent importance in this volume, so far as the student of science is concerned, are those dealing with palæobotany, pathology, and physiology, though there are many other articles of a less exhaustive kind dealing with problems of great scientific interest. Technological questions receive due attention, and are represented, among others, by essays on navies, ordnance, paper manufacture, petroleum, photography, and elec-

tric, hydraulic, and pneumatic power transmission. Students of geography and history are provided with an abundance of material, including the latest statistics referring to the chief countries of the world the names of which fall alphabetically between Natal and Portugal, besides an elaborate account of the polar regions, and an able review of the present state of our knowledge of oceanography. Mathematicians will find the article on "Number" both interesting and original, and readers who prefer biographical studies will meet with appreciative estimates of the lives of such celebrities as Owen, Paget, and Pasteur, to name only three.

But no mere mention of a few of the contents can serve more than to give a vague idea of the variety of valuable material brought together in this volume, and the space available makes it possible to refer only to a few of the chief contributions.

The prefatory essay of this volume—and it must be remembered that these essays are a distinguishing characteristic of this new edition—is by Mr. Frederick Greenwood, and deals with the influence of commerce on international conflict. In this scholarly presentation of an important problem, Mr. Greenwood shows how the growth of commerce has given rise in recent times to dreams of the extinction of war. He goes on to explain, however, how war became later to be regarded as a trade weapon and an instrument for the provision of new markets; and as the discoveries of men of science have placed resources for the destruction of men at the disposal of the armies of the world so terrible in their efficiency that, to ensure any chance of success in a war between great Powers, each of them must have armies so large and so expensively equipped as to lead to a growing likelihood of war becoming so dreadful and so costly that it would not be endured. Yet notwithstanding the horror and brevity of modern battles, humanity still seems able to bear the excess, and militarism flourishes.

Of another factor influencing the industrial competition of the nations Mr. Greenwood takes no notice, and that is the increased attention being paid by the leading nations to the higher education of their manufacturers and merchants. The combined efforts of armies and nations are not enough to secure commercial supremacy. A nation must, in addition, provide a sufficient number of institutions of higher education to secure opportunities for its citizens to become conversant with modern scientific knowledge, able to apply the principles of science to modern industrial problems, and to extend the bounds of science into the unknown. The volume itself does not, we find, ignore the importance of higher technical education, for in addition to articles with a less direct bearing on the subject, an essay on polytechnics by Sir Joshua Fitch is included. The subject does not appear to have been allotted the amount of space its importance merited, and the consequence is that metropolitan polytechnics are alone described. It is a pity that the opportunity could not have been taken to familiarise British readers with the complete and lavish provision of institutions abroad corresponding to these polytechnics. The comparison to which such an article must have given rise

would have shown England's lamentable deficiency and the low position she must be assigned when the sacrifices made by the leading peoples for the establishment of institutions of the higher learning are passed in review.

#### BIO-CHEMISTRY.

*The Chemical Changes and Products Resulting from Fermentations.* By R. H. Aders Plimmer. Pp. vi + 184. (London: Longmans and Co., 1903.) Price 6s. net.

THE number of chemists who are interested in biological problems is now gradually on the increase, whilst, on the other hand, the biologist realises the importance of a further investigation of the chemical changes concomitant with life. In these circumstances, the book of Dr. Aders Plimmer cannot fail to be particularly welcome, and the perusal of this admirable *résumé* of the work in the borderland between biology and chemistry will indicate to the reader how much has been done and how much still remains to be done in this most difficult field of research.

Under his treatment of polysaccharides the author gives a succinct account of the chemistry of starch, and then proceeds to discuss the changes undergone by monosaccharides and glucosides. In this connection due prominence is given to the recent important observations of Croft Hill, Emmerling and E. Fischer and E. F. Armstrong on reversible ferment action. In the chapter on changes in esters reference is made to the work on lipase, where Kastle concludes that ferments do not act on substances which can be electrolytically dissociated. It should be noted, however, that Slimmer has subsequently pointed out that this view cannot be maintained, since glucovanillic acid and other electrolytes are attacked by emulsin. Other chapters include changes in urea and uric acid, blood, albumins, and changes occurring as a result of oxidation and reduction. Nitrification and denitrification are also considered, and the volume is completed by an account of the changes occurring as the result of putrefaction.

It is pointed out in connection with lactic acid production by microorganisms that the usual product is the inactive acid, but that one of the pure optically active forms may sometimes be obtained. In this latter case the author is apparently of the view that the inactive acid is first of all formed and then converted into the one active form by the selective action of the organism. Experimental evidence, however, seems to show that, if the action were of this nature, the resulting product would not be the pure active acid but rather a mixture of inactive and active acids. Frankland's resolution of *i*-glyceric acid, where the one active constituent is attacked by *Bacillus ethaceticus* and the other apparently remains untouched, is altogether exceptional. In those cases, however, where the lactic acid obtained is optically active, but is mixed with some of the inactive form (as in Harden's experiments on the action of *Bacillus coli communis* on *d*-glucose, &c.), the possibility of the intermediate